WORLD SB14 BARCELONA October 28/30th 2014

Social Indicators in the Sustainable Refurbishment: Calculating *Quality of Life* Indicator in a Residential Building in Málaga

Abstract: *How can we measure 'quality of life'? The sustainable refurbishment goes beyond strictly energy aspects. Sustainability indicators are needed to facilitate data collection and to provide information which does not require too time-consuming calculations. Thus, you can offer an idea of the extent and quality of the rehabilitation before starting the project and, also, the obtained results can be evaluated in an agile way after the refurbishment.*

From a list of social indicators gathered from different methods, sustainability assessment tools and International and European standards, three social indicators are proposed: Users Satisfaction, Participation Agreement and Quality of Life. This paper shows the development of Quality of Life social indicator, the more closely related to the main objectives of Research and Development Project "Sustainable Refurbishment": improving energy efficiency and wellbeing of users in existing residential buildings. Finally, this social indicator is applied to a real case study in Málaga (Spain).

Sustainability Indicators, Social Indicators, Sustainable Refurbishment, Quality of Life

Introduction

"Sustainable Refurbishment (RS)" Research and Development Project is supervised by the *Centro para el Desarrollo Tecnológico e Industrial (*CDTI) from the Spanish Government. One of its priorities is to sensitizing users about the necessity of undertaking energy renovations. Thus, new formulas must be found to invite users to become more involved in the general condition of their buildings and to highlight their positive aspects. The RS project aims to develop an integrated model for sustainable rehabilitation of residential buildings based on a scoreboard of environmental, social and economic sustainability indicators that helps in the decision-making process of the refurbishment. The Construction Company FCC, the leader of the project, has as a priority the ease and flexibility of use of the system of indicators to assess the building in different phases: diagnosis, evaluation, comparison and tracking.

The Global Social Indicator developed in RS Proiect to evaluate any residential existing building is composed by three principal indicators: *User Satisfaction*, *Participation Agreement* and *Quality of life*. This paper summarizes the development of one of them, the social indicator called *Quality of Life* and the results of its application in a residential building in Málaga (Spain), 140 dwellings in Jacinto Benavente Avenue. The application of this social indicator allowed knowing the state of social aspects in the building and quantifying them. Furthermore, it was useful to determinate the areas of improvement in residential buildings from the social point of view.

Background

When talking about sustainable refurbishment, energy efficiency is just a part of the overall decision-making process. It is essential for the construction sector to communicate properly the important contribution that sustainable or green buildings can offer to users' well-being on a long-term basis [Feifer, 2011]. There is a general agreement about sustainability indicators as a useful tool to communicate the performance of a sustainable building on several levels, but keeping it simple is essential to bring the science and the construction sector closer.

Indicators are useful to manage information about complex issues such as sustainability, because they try to prioritize in an issue with multiple perspectives and they provide data to evaluate a process in different stages. The ongoing dialogue required between all decision makers to negotiate appropriate compromises in every stage is recognizing Key Performance Indicators (KPIs) as a useful tool to reach consensus amongst stakeholders [Feifer, 2011]. However, the successful transformation of the individual understanding into high quality indicators is a complex issue and more research is needed about the procedure to do this.There is a need for sustainability indicators in order to assess progress towards a goal but the simplification of complicated issues can be misleading and it is important to take into account the context in which they are going to be used [Ghosh et al., 2006]. If they are too complex or numerous they will not be understood by the non-expert population. It is also important to consider how far they are applicable to the process of change. In order to communicate different degrees of sustainability, we need common references that can be understood and handled by peers, professionals, policy makers, politicians and the public in general [Feifer, 2011] and, above all, these must be useful to drive action in the construction sector towards the best practices in sustainable construction issues. Feifer proposes considering the categories and indicators in the CEN TC/350 as a common denominator. They could be a point of departure, allowing for differences of opinion and, at the same time, giving an overall consensus framework.

The European Norm EN 15643-3:2012 [CEN/TC 350, 2012] concentrates social dimension of sustainability on the assessment of aspects and impacts of a building expressed with quantifiable indicators. Social performance measures will be represented through indicators for the following social performance categories: Accessibility, Health and Comfort, Loadings on the neighborhood, Maintenance, Safety / Security, Sourcing of Materials and Services and Stakeholder Involvement.

The categories and criteria that include “social aspects” are not clearly defined in some of the methods and environmental tools reviewed such as the American GREENGLOBE, the Australian GREENSTAR or NABERS, the Japanese CASBEE or the GBTOOL. Whereas, for example, the Spanish *Valor de Eficiencia de Referencia De Edificios* (VERDE), *Hexálogo ASA* (Asociación Sostenibilidad y Arquitectura) or *Guía de edificación sostenible para la vivienda en la Comunidad Autónoma del País Vasco* (GESVPV) are more explicit collecting social aspects,as well as the North American LEED and some of the schemes of the British BREEAM Communities. In general terms, social aspects in environmental tools are more related with town planning than with the specific building.We deduced from the criteria they consider as social aspects which issues should be considered as “social” in this research.

Methodology

Both, bottom-up and top-down approaches were considered to develop the final list of social indicators that compose the *Quality of Life* indicator. The following steps are followed:

1. Compilation of a set of 53 social indicators/subindicators. Taking into account EN 15643-3 as an overall consensus framework, we selected some of the criteria considered in the review as 'social' aspects for the system of indicators established in this research, and developed other new criteria.

2. Elaboration of a structured list (Table 1, first column). The three main indicators that are proposed to compose *Quality of Life* indicator (*1-Health and Comfort*, *2-Universal Accessibility and Design for All* and *3-Common Services*) are divided into subindicators that deal with more specific aspects in order to facilitate its quantification. First, the regulatory requirements of Spanish Building Code (CTE) for new buildings were analyzed in order to adapt those criteria to existing buildings, looking for ways to implement those rules to them. Other compulsory Spanish regulations such as Energy Efficiency Certification or Local Town Planning Regulations were considered. Second, other criteria related to green buildings were studied to complement compulsory requirements.

3. Establishment of an objective, a calculation method and a measurement unit for each indicator/subindicator. The calculation methods are obtained from CTE, from sustainability assessment tools such as VERDE [Macías 2010] or from new methods proposed by the authors according to other references. The *Universal Accessibility and Design for All* subindicator is developed from a voluntary Spanish standard UNE 17001. Finally, the subindicator *Common Services* is defined following recommendations about important social issues that were found in the literature review.

4. Definition of a benchmarking pattern to assess the degree of sustainability for every criterion:

- 0.00 Unsustainable
- 0.25 The situation is not admissible, but not so severely as in the previous case
- 0.50 Admissible
- 0.75 Satisfactory
- 1.00 Appropriate, it reaches the target and places the building in good condition for the future maintenance

5. Weighting of the indicators/subindicators in order to obtain a global social indicator. A first weighting proposal was made, according to references, experience and RS priority objectives. This proposal was agreed with FCC Company, and revised as the system of indicators developed throughout the project.

6. The Table 1 is completed in this way and summarizes indicator *Quality of Life* broken down into 53 subindicators, their benchmarking and weighting.

7. Theorical application of the group of social indicators on Table 1 to a pilot building of RS project. This is a building composed by 140 public housing units for rent for people with low income in Málaga (Andalucía). There are three main types of housing A, B and C. The type A has a terrace that has been modified and closed by users in some cases, so, two types of A dwelling are considered: A with open terrace and Ac with enclosed terrace. For each of them all the indicators are calculated, in order to achieve a global assessment of the whole building.

Results

Table 1 shows the breaking down of social indicator *Quality of Life* in subindicators, their benchmarking and weighting.

Regarding the implementation of *Quality of Life* indicator in the pilot building, it reaches a value of 0.14 in type A housing (open terrace), 0.09 in type Ac (enclosed terrace) and 0.15 in types B and C. All of them are below 0.25, which results are *Unsustainable* according to the chosen reference pattern.

As for the subindicators *1-Health and Comfort* best value was for type A, B and C housing with 0.23. In type Ac the value is lower 0.13. All of them are *Unsustainable*. Type A has a better value because it is the only one that fulfills subindicators *1.4.1 Ratio of Glazing to Room Area (*)* and *1.6.1 Means of Natural Ventilation (*)* which are *sine qua non* requirements. B and C get 0.23 marked with an asterisk (*) that means the punctuation is not valid until they fulfill *sine qua non* requirements.

The results of subindicator *2-Universal Accesibility and Design for All* are the same for all the housing types because they have been calculated at building level, and it reaches 0.04. The results in *3-Common Services* is better in B, 0.13, because of the indicator *Flexibility of Use* which is better in B. A, Ac or C get 0.09 at *Common Services* subindicator.

This way, looking to the punctuation of all the criteria, we can decide the improvement measures for the building. For example, existing housing type A get 0.00 at *Cross Ventilation Possibilities* because it does not fulfill this criteria. If it had 1.00 at *Cross Ventilation Possibilities* subindicator the *Health and Comfort* subindicator would be 0.27, not admissible, but not so severely as in the previous case (0.23). The evaluation of the building and the decision making process can be done looking to the table in an easy and flexible way.

1 Health and Comfort (50%)							
1.1 Hygrothermal Comfort (15%)	**1.1.1** Energy Efficiency Certificate (50%)	EEC	n/d	D	C	B	A
	1.1.2 Room temperature personal control in winter (25%)	-	No		L	L&B	Yes
	1.1.3 Room temperature personal control in summer (25%)	-	No		L	L&B	Yes
1.2 Indoor Air Quality (15%)	**1.2.1** Ventilation system (40%)	-	No				Yes
	1.2.2 Cleaning before occupation (20%)	-	No				Yes
	1.2.3 Use of healthy building materials (20%)	%	n/d	0	30	60	90
	1.2.4 Radon concentration (20%)	-	n/d		n/r		Yes
1.3 Acoustic Comfort (15%)	**1.3.1** Façades, roofs and floor in contact with the exterior (40%)	-	No		SRQ		Yes
	1.3.2 Vertical separation elements and party walls (20%)	-	No		SRQ		Yes
	1.3.3 Horizontal separation elements (20%)	-	No		SRQ		Yes
	1.3.4 Partitions (10%)	-	No		SRQ		Yes
	1.3.5 Installations/Equipment noises (10%)	-	No		SRQ		Yes
1.4 Visual Comfort (15%)	**1.4.1** Glazing surface-to-floor area ratio (*) (40%)	%	*Sine qua non* requirement				
	1.4.2 Daylighting in bathrooms (10%)	%	0	40	60	80	100
	1.4.3 Daylighting in common areas (10%)	%	0	20	40	60	80
	1.4.4 Personal control (10%)	%	50	70	80	90	100
	1.4.5 Daylight factor (10%)	%	1	2	3	4	5
	1.4.6 Inside privacy protection (10%)	%	20	40	60	80	100
	1.4.7 Outside views (10%)	-	< 45	45	60	75	90
1.5 Sunlight (8%)	**1.5.1** Zonification (50%)	-	20	40	60	80	100
	1.5.2 Minimum sunlight (25%)	-	20	40	60	80	100
	1.5.3 Sun shading (25%)	-	20	40	60	80	100
1.6 Natural Ventilation (8%)	**1.6.1** Means of natural ventilation (*) (50%)	-	*Sine qua non* requirement				
	1.6.2 Cross-ventilation possibilities (50%)	%	20	40	60	80	100
1.7 Protection from Humidity (8%)		-	No				Yes
1.8 Electromagnetic Radiation (8%)		-	No				Yes
1.9 Use of Vegetation (8%)	**1.9.1** Low energy techniques (75%)						
	a Green roof	%	0	20	40	60	80
	b Green façade	%	0	5	10	15	20
	c Trees or other shading natural elements	%	0	5	10	15	20
	d Patios or plots with gardens	%	0	20	40	60	80
	1.9.2 Generation of educational or leisure activities (25%)		No				Yes

2 Universal Accessibility and Design for All (30%)							
2.1 Accessible Itineraries during Renovation Works (10%)		-	No				Yes
2.2 Walking (common areas) (30%)	**2.2.1** Pavements (25%)	-	No				Yes
	2.2.2 Maneuvering and approximation spaces (25%)	-	No				Yes
	2.2.3 Circulation and rest areas (25%)	-	No				Yes
	2.2.4 Changes of plane (25%)	-	No				Yes
2.3 Walking (inside dwellings) (15%)	**2.3.1** Provision of accessible housing in the building (100%)	-	n/d	< n	n	> n	100%
2.4 Apprehension (15%)	**2.4.1** Grasping (25%)	-	No				Yes
	2.4.2 Actuation (25%)	-	No				Yes
	2.4.3 Gripping (25%)	-	No				Yes
	2.4.4 Transportation (25%)	-	No				Yes
2.5 Location (15%)	**2.5.1** Lighting (40%)	-	No				Yes
	2.5.2 Signaling (30%)	-	No				Yes
	2.5.3 Orientation (30%)	-	No				Yes
2.6 Communication (15%)	**2.6.1** Visual (40%)	-	No				Yes
	2.6.2 Acoustic (30%)	-	No				Yes
	2.6.3 Tactile (30%)	-	No				Yes

3 Communal Services (20%)							
3.1 Cleaning and Maintenance (use) (40%)	**3.1.1** Cleaning (50%)	%	0	2	4	6	10
	3.1.2 Maintenance (50%)	-	No				Yes
3.2 Employment Creation/Local Sensitivity (social integration) (15%)		-	No				Yes
3.3 Common Facilities for Users (15%)		%	0	1	2	3	4
3.4 Common Facilities for External Neighbourhood (15%)		%	0	0.5	0.7	1	1.2
3.5 Flexibility of Use (15%)		-	> 1.4	1.4	1.3	1.2	< 1.2

(*) *Sine qua non* requirement L Living room n/r No risk n Number of obligatory accessible dwellings
n/d No data available L&B Living room and bedrooms SRQ Sustainable Refurbishment Questionnaire

Table 1 Social Indicator Quality of Life. Subindicators, Benchmarking and Weighting

Figure 1 shows the obtained results for each housing type in Jacinto Benavente residential building broken down into subindicators *1-Health and Comfort*, *2-Universal Accesibility and Design for All* and *3-Common Services.* Results show that none of the housing units reach the minimum score in *Quality of Life* indicator; all of them are below 0.25, while admissible level is 0.50. The Type Ac, with the enclosed terrace, gets the worst punctuation in *Quality of Life* indicator with 0.09. The parameters marked with an asterisk (*) indicate that the two indispensable requirements are not fulfilled: *1.4.1 Ratio of Glazing to Room Area (*)* and *1.6.1 Means of Natural Ventilation (*).* The refurbishment should not be undertaken until these *sine qua non* subindicators or prerequisites get 1.00. The bottom bar indicates the total maximum possible score for each subindicator.

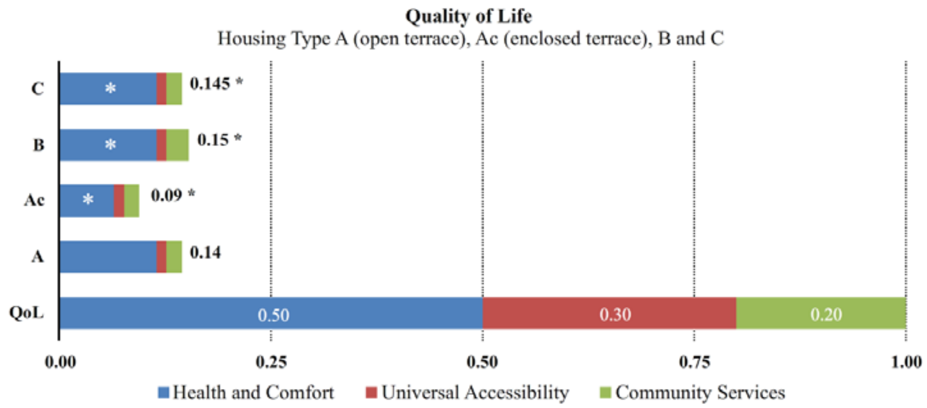

Figure 1. Results of Quality of Life social indicator for Jacinto Benavente residential building in Málaga.

Figure 2 shows the results of *Health and Comfort* subindicator for the types A, Ac, B and C, disagreggated in 9 subindicators. The bottom bar indicates the total maximum possible score for each subindicator. It is observed that none of the dwellings reach an admissible situation (0.25). The type A, B and C gets the best punctuation 0.23. The types Ac, B and C highlighted with an asterisk require, first of all, solving the problems identified with subindicators *1.4.1 Ratio of Glazing to Room Area (*)* and *1.6.1 Means of Natural Ventilation (*)* in terms of visual comfort and natural ventilation.

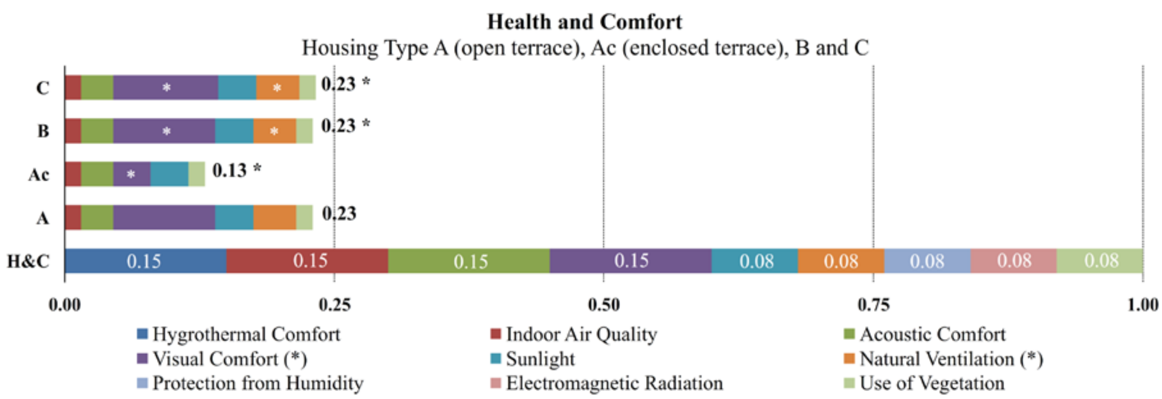

Figure 2. Results of Health and Comfort subindicator for Jacinto Benavente residential building in Málaga.

Conclusion

The application of *Quality of Life* indicator was useful to analyze the possibilities to improve the envelope, beyond energy aspects. This way, different solutions to improve the building can be assessed to guide the refurbishment towards enhancing social aspects.These subindicators are helpful to prioritize between different needs in the building and to plan a progressive refurbishment.

Calculating the subindicators for every type of housing accelerates the building assessment; seventeen of them were calculated for every type of housing and thirty six for the whole building.

As results show, all the types of housing are *Unsustainable*. As a consequence the building requires refurbishment to achieve a minimum level of social sustainability, beginning to solve the problem with the *sine qua non* requirements Ratio of Glazing to Room Area (*) and Means of Natural Ventilation (*).

This case study has enabled to analyze the indicators in order to reduce them for the final scoreboard developed in RS Project.

Aknowledgement

The first author appreciates the scholarship for training research staff of the Polytechnic University of Madrid funded by the companies that collaborate in the RS project and by the CDTI.

References

CEN/TC 350 (2012). Sustainability of construction works — sustainability assessment of buildings — part 3: Framework for the assessment of social performance. EN 15643-3

Feifer, L. (2011). Sustainability indicators in buildings: Identifying key performance indicators. PLEA 2011 - Architecture and Sustainable Development, Conference Proceedings of the 27th International Conference on Passive and Low Energy Architecture, 133-138.

Ghosh, S., Vale, R., & Vale, B. (2006). Indications from sustainability indicators. Journal of Urban Design, 11(2), 263-275. doi:10.1080/13574800600644597

Macías, M. y García Navarro, J.: “Metodología y herramienta VERDE para la evaluación de la sostenibilidad en edificios”, Revista Informes de la Construcción, Vol.62 nº517 pp. 87-100, Instituto de Ciencias de la Construcción Eduardo Torroja CSIC, Madrid, Enero-Marzo 2010.